Department: Elect/Elect Engr.
Matric No: 17/ENG04/054

① Unity = 1

$$C = \frac{KVAR}{2\pi f v^2}$$

KVAR = Px.

actual P.f = $\cos\theta$ = 0.7

$\theta = \cos^{-1} 0.7$

= 45.57

$\tan(45.57) = 1.020$

target P.f ⇒ $\cos\theta = 1$

$\theta = \cos^{-1} 1 = 0$

$\tan\theta = 0$

KVAR = 74.6 × (1.0201 - 0)

= 76.0175

= 76.1

$$C = \frac{76.10}{2\pi \times 50 \times 415^2}$$

= 1.4 × $m^{-6}$c

ii) 0.9 lagging

actual P.f = 1.0201

target P.f = $\cos\theta$ = -0.9

$\theta = \cos^{-1}(-0.9)$

$\theta = 154.16$

$\tan\theta = \tan(154.16)$

= -0.48

KVAR = 74.6 × (1.0201 - (-0.48))

= 111.90

≈ 112

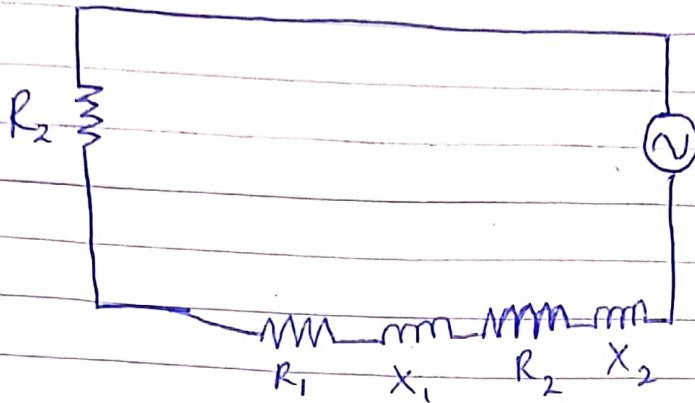$$C = \frac{KVAR}{2\pi f v^2} = \frac{112}{2\pi \times 50 \times 415^2}$$

= 2.068 × $10^{-6}$c

(2)(i) $Z_1 = 0.25 + j0.75$ ..... Stator

$\qquad Z_2 = 1.173 + j0.52$ ---- rotor



$$R_1 \quad X_1 \quad R_2 \quad X_2$$

Supply Voltage per phase, $V = \dfrac{415}{\sqrt{3}} = 239.60V$

Reffering to motor;

$R_{02} = (R_2 + k^2 R_1)$

$\qquad = (1.173 + (5/6)^2 \times 0.25)$

$R_{02} = 1.347 \, \Omega$

$X_{02} = (X_2 + k^2 x_i)$

$\qquad = j(0.52 + (5/6)^2 \times 0.75)$

$\qquad = 1.041$

$Z_{02} = R_{02} + X_{02}$

$\qquad = 1.547 + j 1.041$

$Z_{02} = \sqrt{1.547^2 + 1.041^2}$

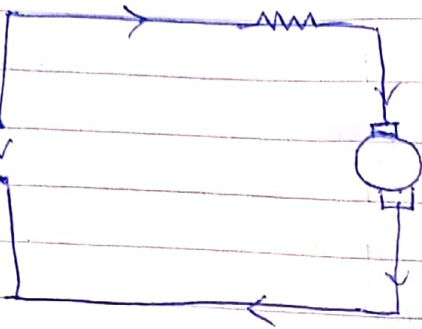$\qquad = 1.7 \, \Omega$

(ii) Rotor Current

$\qquad I_2 = \dfrac{E_2}{Z_{02}}$

Recall $E_2 = kV_1$

$\qquad = 239.6 \times 0.83$

$\qquad = 199.67N$

$\therefore I_2 = \dfrac{199.67}{1.7} = 117.45A$

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## (3)i)



$$\frac{N_2}{N_1} = \frac{Eb_2}{Eb_1}$$

$$\frac{Ebac}{E} = \frac{Nac}{Ndc}$$

$$\Rightarrow Nac = 2000 \times \frac{202.52V}{209.5V}$$

$$Nac = 1933.37 \, rpm$$

ii) Power factor of the motor

$$\Rightarrow \frac{202.52 * 10}{220}$$

$$= 0.968 \, lagging$$

iii) Torque developed by the motor

$$= Ebac \times I$$

$$\therefore Tac = \frac{Ebac \times I}{W}$$

Where $W$ = Speed in rad/s

iv) Universal Motor